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ON A COLLECTION OF *GARDNERULA CORYMBOSA* (HARVEY) J. DE TONI[1]

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With one Text-figure

The establishment of *Gardnerula*, one of the genera of Rivulariaceae, is by J. DE TONI in 1936. According to the International Rules of Nomenclature in the Third International Botanical Congress at Brussel in 1910, the starting points for names of the Nostocaceae heterocysteae is with BORNET & FLAHAULT'S Révision des Nostocacées hétérocystées (1886–1888). However, basing upon the revised rules by the International Botanical Congress at Cambridge in 1930, J. DE TONI (1936) described a new combination genus *Gardnerula* into which the genus *Polythrix* which had been valid was combined, thus *Gardnerula corymbosa* (HARV.) J. DE TONI was established. Under the name of *Gardnerula corymbosa* are *Microcoleus corymbosus* HARV., *Polythrix spongiosa* ZANARD., and *Polythrix corymbosa* GRUNOW in herb. which had been placed under the species of *Polythrix corymbosa* by BORNET & FLAHAULT (1886) and *Sirocoleum Jensenii* WEBER VAN BOSSE (1926) which had been a species of Lyngbyae, Oscillatoriaceae, made as a synonym respectively. The genus *Polythrix* was established by G. ZANARDINI in 1872, based upon the type species *Polythrix spongiosa*. Before the genus was established, W. HARVEY in 1858 reported *Microcoleus corymbosus* as a new species in his Nereis Boreali-Americana, Part III. Afterwards, E. BORNET & C. FLAHAULT in 1886 ascertained from A. GRUNOW's Herbarium *Polythrix corymbosa* into which *Microcoleus corymbosus* was combined, and under the new combination species they placed *Polythrix spongiosa* given by G. ZANARDINI as a synonym.

Since then little attention has been attracted to the genus *Polythrix* by phycologists. However, J. TILDEN (1910) and L. GEITLER (1932) enumerated *Polythrix corymbosa* (HARV.) GRUNOW in their books respectively. In 1926, A. WEBER VAN BOSSE described a new species *Sirocoleum Jensenii* whose trichome is distinctly tapering into a hair at its apex and possesses cylindrical heterocysts, and he placed it in the family Oscillatoriaceae. Afterwards, as above mentioned the species was combined into the genus *Gardnerula* by J. DE TONI.

In 1952 the writer reported a list of marine Cyanophyceae from the Shirahama

1) Contributions from the Seto Marine Biological Laboratory, No. 281.

coast of Wakayama Prefecture. He has kept on studying unidentified specimens collected on that opportunity in 1951, and has discovered a noteworthy species of *Gardnerula corymbosa* (HARV.) J. DE TONI which is a new record for the Japanese flora. Furthermore he had collected in great abundance well matured specimens of the species in April 1955, when he had an opportunity for collecting the marine Cyanophyceae of Amami-Oshima of Kagoshima Prefecture, the southernmost island in Japan. The frond from Shirahama was found growing among the strata of other algae mixed with fine sand, on rocks in the upper littoral zone. The frond is yet young and is much smaller, measuring a range from 150 μ to 1300 μ high. The trichome, however, is rather thicker, 7.5–16.5 μ in diameter at its base and 4.5–12 μ in diameter at its middle. On the other hand, the alga from Amami-Oshima was found on rocks in the upper littoral zone or along the high tide level, forming velvety strata widely expanded, and the frond is 4–7 mm in height, well matured, forming abundant hormogonia in the apical portion of the branch. In size the frond from Amami-Oshima corresponds with the descriptions of *Microcoleus corymbosus* by HARVEY and of *Sirocoleum Jensenii* by WEBER VAN BOSSE. The diameter of the trichome is 7–15 μ, mostly 9–12 μ at its base, 5–13 μ, mostly 6–9 μ at its middle. On the whole, the Amami-Oshima specimen, except the height of frond, is much the same as that of Shirahama. ZANARDINI's original diagnosis of *Polythrix spongiosa* is as follows: Frondibus lineam altis, 1/40‴ crassis; filis tenuissimis, 1/900‴ crassis. According to HARVEY the fronds of *Microcoleus corymbosus* HARV. are described to be from a eighth to a quarter of an inch in length. In the diagnosis of *Polythrix corymbosa* GRUNOW, BORNET & FLAHAULT (1886) described that the thallus is 1–3 cm high and the trichome is 5–6 μ in diameter. In *Sirocoleum Jensenii* WEBER VAN BOSSE the frond is 1 cm high, the filament 120–260 μ broad and the trichome 3.6–5.4 μ broad, rarely 7.2 μ. Generally in the Japanese materials the trichomes are somewhat thicker.

For the determination of this alga the writer sent the specimens from both Shirahama and Amami-Oshima to Dr. F. DROUET asking his opinion. He kindly wrote the writer that they are exactly included under the specific name of *Gardnerula corymbosa* (HARV.) J. DE TONI and sent to the writer many specimens from Bermuda, Jamaica, Israel, the Hawaiian Islands and the Philippines; with those the Japanese specimens accorded very well. All of these fronds are up to 4 mm in height and the trichome 3–12 μ, mostly 5–7.5 μ in diameter at the middle.

In both Shirahama and Amami-Oshima specimens, the intercalary heterocysts are formed not only in old plants but also in young ones and mostly cylindrical, rarely quadrate in shape, having a length of 10 μ to 25 μ. Because the frond from Amami-Oshima was adult and well matured, numerous hormogonia were found at the apical portion of the branch, single or two within a sheath, being short- or long-cylindrical. Because of still being young in Shirahama specimen their formation could not be found.

It seems that the reproduction of this species is performed by means of the

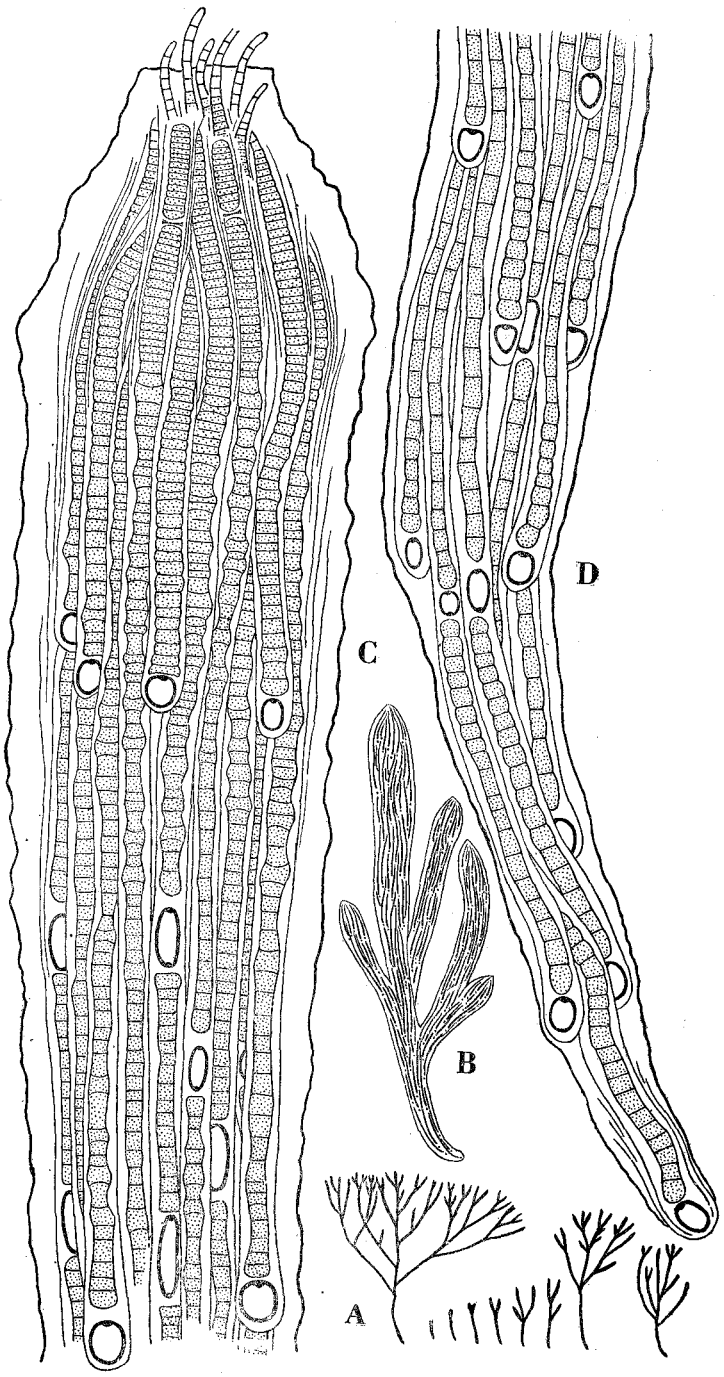

Fig. 1. *A*, habit showing the various stages of fronds. ×3. *B*, frond showing the arrangement of the filaments. ×25. *C*, apical portion of the branch of a frond. ×240. *D*, basal portion of a frond. ×240.

hormogone and the fragmentation of the branch. The frond is branched dichotomously or irregularly, and later the branched small parts fall apart from the matured main frond, and grow into new individuals. It is often found that by slight mechanical pressure the branches are readily falled apart from the main frond.

From the characteristics that the trichome is tapering into a hair at the apex and has a basal heterocyst, the genus *Gardnerula* may be placed in the family Rivulariaceae as reported by BORNET & FLAHAULT (1886), FORTI (1907), TILDEN (1910), GEITLER (1932) and DROUET (1951). Among the genera of that family the present genus may be placed between *Rivularia* and *Dichothrix* rather than between *Dichothrix* and *Calothrix* because of the feature that the repeatedly branched filaments are radiating from the base upwards in a frond. But the genus *Gardnerula* is considered quite distinct from the genus *Rivularia* by the peculiarly branched frond. Apparent differences from the genus *Dichothrix* lies both in the most simple frond and in enclosing compactly arranged numerous filaments in the frond.

Gardnerula J. DE TONI 1936

(Syn. *Polythrix* ZANARDINI 1872)

Gardnerula corymbosa (HARVEY) J. DE TONI 1936

Syn. *Microcoleus corymbosus* HARV. 1858; *Polythrix spongiosa* GRUN. in herb. in BORN. & FLAH. 1886; *Sirocoleum Jensenii* WEBER VAN BOSSE 1926.

Fronds dark blue-green, widely expanded and forming velvety strata on rocks, subdichotomously or irregularly branched, 4–7 mm in length, 30–80 μ in diam. at the basal portion, 60–300 μ in diam. at the branched upper portion; common teguments thick, somewhat gelatinous, rough on the outer surface, hyaline, but the inner part yellowish or light brown, lamellated; filaments repeatedly branched from the base upwards, tight-parallel; sheaths of filaments hyaline, but above often light brown, lamellated, divergent; trichomes blue-green, somewhat thicker at the base, 7–15 (mostly 9–12) μ in diam. at the base, 5–12 (mostly 6–9) μ in diam. at the middle, above tapering gradually or abruptly into a long or somewhat short hyaline hair; cross walls constricted or not; cells generally shorter above, 3–7.5 μ in length, 1–1/4 time as long as the diameter, below longer, 4–16 μ in length, 3–1/3 times as long as the diameter; heterocysts basal, often both basal and intercalary; the basal ones single, 6.5–15 μ in diam., hemispherical, spherical or ellipsoidal; intercalary ones single, rarely two in series, mostly cylindrical or ellipsoidal, 10–25 μ in length, a little thicker than the diameter; hormogonia one or two within the sheath, 15–30 μ in length.

Japanese name: Ōhigesō (n. n.).

Hab.: On rocks in the upper littoral zone or along the high tide level. Koniya, Amami-Oshima, Kagoshima Pref. April 10 & 11, 1955. Nos. 1787, 1798, 1799, 1800, 1801, 1802 (in Herb. UMEZ.); growing among the strata of other blue-green Algae mixed with sand, in the upper littoral zone. Seto, Shirahama, Wakayama Pref.

November 2, 1951. No. 550 (in Herb. UMEZ.).

Distribution: North America (Florida), Atlantic Ocean (Bermudas), Pacific Ocean (Hawaii, Tongatabu, Kei, Philippines), Malay (Singapore), Mediterranean (Israel), West Indies (Jamaica).

The above description is based upon the materials collected at Koniya in Amami-Oshima.

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